

Takt 10 creates Germany's busiest cross-city link

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COMMUTERS in München have enjoyed greatly enhanced levels of service since December 13 2004. Service frequency has been doubled on the S-Bahn routes from Maisach, Zorneding, Germaring-Unterpaffenhofen and Deisenhofen, with trains running every 10 min during the morning and afternoon peak hours.

From 06.30 to 09.00 on Mondays to Fridays and from 15.30 to 19.00 on Mondays to Thursdays the 10 min interval service on these routes has given passengers more flexibility in planning their journeys, while loads have been spread more evenly. Passengers know that they will never have to wait longer than a few minutes for the next train.

Introducing the 10 min interval service was not a simple matter. Planning for the 'Takt 10' service remodelling started back in the 1990s, but only in December 1998 was an agreement covering finance and implementation of this major investment

programme signed by the *Land* of Bayern and German Railway.

The €266m programme covered double-tracking of an 11 km section of the line to Deisenhofen, a 4 km bypass round Berg am Laim, reconstruction of München Ostbahnhof and complete modernisation of the S-Bahn cross-city underground link. Other work included modernisation of numerous stations and remodelling of the service pattern with some routes renumbered.



Heinrich Beckmann
Chairman of the
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Cross-city core

Running between Pasing in the west and Ostbahnhof on the eastern fringe of the city centre, the cross-city tunnel was opened in time for the 1972 Olympic Games. Introduction of 10 min interval services means that many more trains have to be funnelled through the link.

All S-Bahn lines converge on the 11.4 km section from Pasing to

Ostbahnhof – around 1 000 trains every weekday. This means that it is now the busiest main line railway in Europe in terms of the number of services operated, with trains running at 2 min intervals.

Normally there are 27 trains per hour in each direction, but it is

A key component in the capacity enhancement was the installation of LZB inductive train control and cab signalling

The new face of S-Bahn München. A Class 423 EMU calls at Pasing on a test run before entering service

possible to increase this to 30 trains an hour. Elsewhere in Europe this frequency has only been achieved on metro lines, although the Paris RER provides a comparable frequency.

To accommodate this level of service required extensive modernisation of the 30-year-old tunnel. Only by careful planning and rigorous adherence to a tightly-timed work schedule were the contractors able to complete this demanding and comprehensive programme in the time window available.

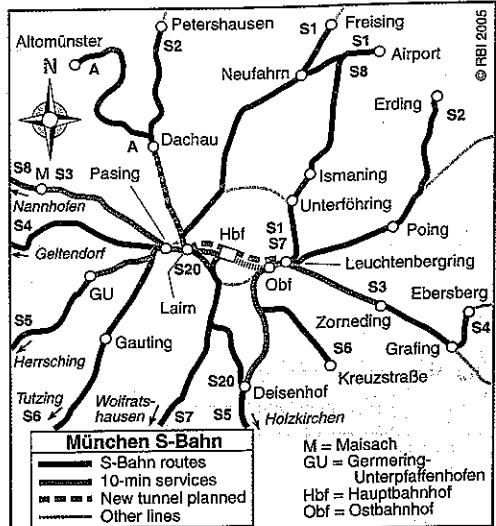
The work required 49 weekends and more than 200 weekdays when the line was completely closed or operated with single-line working. Between January 2003 and August 2004 around 200 km of signalling cables were laid, 349 signals erected, and a new modular control centre built and commissioned.

Achieving the increase in line capacity would not have been possible without resignalling. LZB inductive train control was installed, and this went live in November 2004 – the first time that LZB has been used on a S-Bahn route in Germany. LZB provides continuous speed supervision, with a screen in the driver's cab displaying the maximum permissible speed and the distance to the next stop signal or location where the line speed changes. The information is updated every second.

Rolling stock fleet replaced

Modernisation of the rolling stock fleet was also essential. The entire fleet of ET420 three-car trains dating from the 1970s was replaced by 234 Class ET423





trainsets by mid-2003. The whole process took four years and absorbed around €790m, of which Bayern provided €180m.

The ET423 is an articulated lightweight design with regenerative braking and a maximum speed of 140 km/h. Each air-conditioned set seats 192 passengers with room for 352 standees; visual and audio passenger information is provided, with some messages given in English.

An essential part of the job was a comprehensive staff training programme so that everyone was thoroughly familiar with the new equipment and the new trains. No fewer than 551 drivers had to be trained on the ET423, and considerable use was made of a driving simulator so that drivers were truly familiar with the function and operation of LZB.

Another 120 station and platform staff had to be trained too. The role of these employees is to provide passengers with information about services, but their most important task is to ensure that the 30 sec station dwell time on the cross-city link between Pasing and Ostbahnhof is strictly adhered to. They ensure that trains are dispatched on time, as failure to do so would jeopardise the very tightly programmed timetable.

Extensive trials were staged during the night in November 2004 to check the feasibility of the 10 min interval service,

involving train control staff, station staff and train drivers. The trials covered a wide range of situations that the staff may encounter, giving them real practice at keeping to the station dwell times in sometimes adverse circumstances.

Responsibility for operating the intensive service is shared by the train control staff. At the beginning of 2004, the dispatchers, crew managers and rolling stock managers were brought together in a single control centre. Having all the decision makers together in this way enables them to work together closely, so that they can rapidly agree on any action to be taken in the event of disruption.

The individual cogs in this new organisation have proved to be well-oiled, and we have seen how the staff have reacted quickly and effectively when required, by organising bus replacement services for example. So-called red telephones have been installed to provide immediate links to the control centres for the city's U-Bahn, tram and bus operations, so that all the controllers can keep their colleagues informed of developments. This also ensures that passengers making their way to and from the S-Bahn are kept informed of potential problems around the network.

Around 20 standard emergency action programmes were worked out for use when the cross-city link is disrupted. The

Reconstruction work to increase the capacity of the cross-city tunnel required extensive daytime and weekend closures between January 2003 and August 2004

aim was to develop an ability to react quickly and flexibly, to ensure that all staff are kept informed and familiar with the altered routines, and to ensure that passengers are kept informed of developments and alternative travel options.

The S-Bahn control centre employs 29 staff, who are responsible for overseeing the operation of 1 100 trains a day on the largest S-Bahn network in Germany.

Second tunnel planned

The München S-Bahn now operates over 442 route-km, with a network of 10 routes serving 147 stations. A typical weekday sees 720 000 trips, with 350 000 on a Saturday and 240 000 on Sundays.

All forecasts suggest that demand will grow in the future, which is why a second cross-city S-Bahn tunnel is being planned parallel to the existing route. Work on the 10 km line with stations at Laim, Hauptbahnhof, Marienhof, Ostbahnhof and Leuchtenbergring is scheduled to start next year, with completion anticipated in 2010. This would offer a Laim – Ostbahnhof trip time of 9 min 30 sec.

The second tunnel will be dug at a depth of 40 m below the surface, and the steepest grade will be 4%. The cost is put at around €1bn, of which 60% would be funded by the federal government and 40% by the Land of Bayern.

The project is currently working its way through the formal approval process, which is expected to take between one and two years. Allowing time for tendering and awarding contracts, we hope to see the start of construction in the autumn of 2006. ■



Introduction of 10 min interval services required the purchase of additional EMUs on top of the fleet renewal programme; the extra sets were funded by the Land of Bayern

Completing Japan's first subway loop

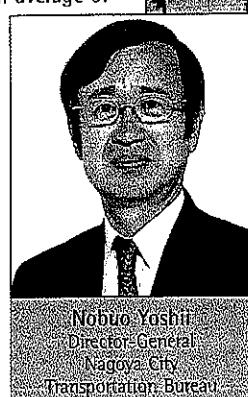
OCTOBER 6 2004 was a very special day for the Nagoya metro. To coincide with the 50th anniversary of the start of construction on the first route, the city inaugurated its latest extension, completing Japan's first true metro ring line.

When the City of Nagoya began work on its first metro in 1954, the initial section of Line 1, the Higashiyama Line, ran for just 2.4 km from Nagoya station to Sakae-machi (now simply known as Sakae). Over the next 50 years, the network has grown steadily, so that by the end of 2004 there were six lines totalling 89.1 route-km.

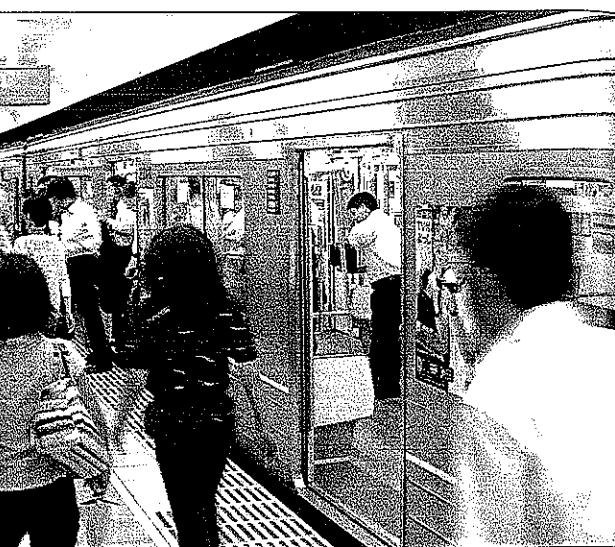
Today, the metro carries an average of 1.1 million passengers a day. This is equivalent to approximately half of the total population of Nagoya City.

The Higashiyama Line is 1 435 mm gauge and electrified using a 600 V DC third rail supply, as are the later Meijo and Meiko lines. The first line grew slowly through the 1960s, reaching 8.5 km in 1963. Two years later we opened the first 1.3 km section of line 2, then known as the Meijo Line, between Sakae and Shiyakusho (City Hall). Both routes were extended in phases until the network reached 32.4 km in December 1971.

The 5.7 km Line 4 from Kanayama to Aratama-bashi in the south of the city opened in March 1974, followed three years later by the 8.0 km Line 3 from Fushimi to Yagoto. Line 3, the Tsurumai Line, was built to 1 067 mm gauge and



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electrified at 1.5 kV DC overhead to permit through running from the private-sector Nagoya Railway, Meitetsu.

Through running began in 1978, following the extension of Line 3 from Yagoto to Akaike, where it makes an end-on connection with Meitetsu's Toyota Line. The other end

of Line 3 was also extended in stages until the opening of the 1.4 km from Shonai Ryokuchi-koen to Kami-otai in August 1993 permitted through running onto Meitetsu's Inuyama Line.

Today Nagoya Metro and Meitetsu share the operation of the Tsurumai Line under a reciprocal rights agreement. A similar agreement also applies to the

0.8 km Kami-Iida Line, which was opened in January 2003 so that Meitetsu's Komaki Line trains can reach an interchange with the Meijo Line at Heian-dori.

Meanwhile, the 6.3 km first section of Line 6 between Nakamura-kuyakusho and Imaike opened in September 1989. Known as the Sakura-dori Line, this was also built to 1 067 mm gauge, so that the trains can share the Tsurumai Line workshop, which is reached via a short connection at Marunouchi. The 8.6 km second section from Imaike to Nonami was opened in 1994.

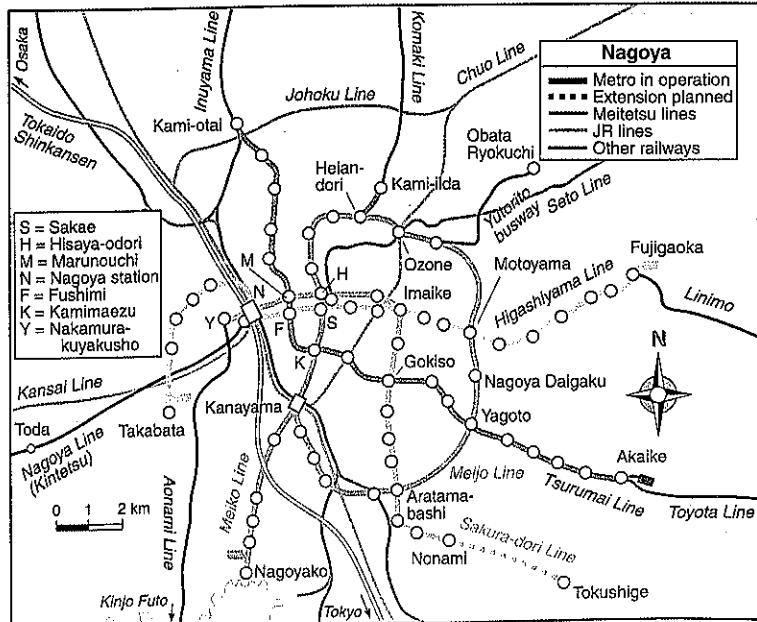
Completing the ring

In 1992 Nagoya City Government adopted a 'Basic Policy' setting out its objectives for development of the metro network to 2008 and beyond.

This led to the significant decision to extend lines 2 and 4 around the eastern side of the city to create a metro loop, mirroring underground the busy elevated motorway ring that encircles the city centre. The ring was intended to improve the connectivity and convenience of the metro network, providing good connections with all five of the other lines.

The eastern side of the ring was completed in three phases over the next decade. First to be completed was a short extension at the northern end from Ozone to Sunada-bashi, which opened in January 2000, serving the new Nagoya Stadium. In December 2003 the line was extended southwards from Sunada-bashi to Nagoya Daigaku, serving the university, via a new interchange with Line 1 at Motoyama.

The ring line project was finally completed on October 6 2004, when the



5.6 km section between Nagoya Daigaku and Aratama-bashi was opened for traffic. With the completion of the loop, the service pattern on Lines 2 and 4 was restructured.

Officially, Line 2 runs from Nagoyako to Ozone and Line 4 from Ozone to Kanayama via Aratama-bashi. Both lines were originally known as the Meijo Line, but now this is taken to refer to the ring, whilst the southern part of Line 2 from Kanayama to Nagoyako (Nagoya Port) was renamed the Meiko Line.

The new section runs entirely underground, and serves four new stations at Yagoto Nisseki, Yagoto, Sogo Rihabiri Center and Mizuho Undojo Higashi. The stations were built using an open box technique, but the running tunnels between them were excavated using a shield tunnelling method. The 50 kg/m rails are laid on a concrete slab substructure incorporating vibration-reduction measures.

With the opening of the final section, the completed loop is 26.4 km long, serving 28 stations in total. The loop is smaller than JR East's Yamanote Line in Tokyo, but larger than JR West's Osaka Loop. It is similar in length to the 'frying pan' section of Toei's Oedo Line in Tokyo.

Meijo Line trains operate in both directions around the ring, with a running time of 48 min. This service is overlaid by the Meiko Line trains from Nagoyako which run through over the northwestern part of the ring as far as Ozone, providing a more intensive service through the city centre. Between Ozone and Kanayama, trains run at headways of between 150 and 210 sec during the morning and evening peak periods. Before 07.00 and after 20.00 the Meiko Line operates as a 10min interval shuttle from Kanayama to Nagoyako.

Expansion continues

Opening of the loop line is not the end of expansion for the Nagoya metro. The Basic Policy strategy set out in 1992 identified a number of potential projects, although it is not definitive and other proposals can also be considered.

Future metro extensions are grouped into three categories. Class A projects will go ahead under agreed timescales, Class B projects are subject to detailed



development and planning work, whilst Class C schemes are to be considered for possible development in the future.

The next major project to go ahead is a 4.1 km all-underground extension of the Sakura-dori Line from Nonami to Tokushige. This will serve the southeastern part of the city, which has seen a remarkable increase in population over recent years. The project was classified as Class A, and the City of Nagoya received permission to build and operate the line in September 2003. Civil engineering construction is expected to get underway in the financial year beginning on April 1 2005, with the line due to open in fiscal 2014.

Other projects were included in the Basic Policy, although we do not have any plans to build them at present.

A special year

2005 is a significant year for the city, as Nagoya is hosting the World Exposition which runs from March 25 to September 25. The Transportation Bureau is responsible for providing access to the Expo site, which is connected to the Higashiyama Line terminus at Fujigaoka station on by the Linimo maglev people mover (RG 9.04 p539). Now known as the Tobukyuryo Line, this

Stations on the newly-completed section of the ring match the architectural style of the older parts of the Meijo Line

8.9 km route was opened for revenue service at the beginning of March.

Another development which came on-stream in time for the expo is the Central Japan International Airport which opened on February 17. This is connected to the centre of Nagoya by Meitetsu's μSKY airport express service which was launched at the end of January (RG 3.05 p220).

With many more international visitors expected in Nagoya this year, the Transportation Bureau took the opportunity of the opening of the ring line to introduce a new multi-lingual metro network map with standardised numbering for all the stations. We expect that this will make the metro much easier to use, both for the visitors from across Japan and from other countries. ■

Prominent markings at the station entrances (below left) make the metro easy to find.

Multi-lingual signage is being introduced to cater for an expected flood of visitors to this year's World Exposition

